

# Engineering and Materials Cost Justification

## WBS ??? : Tile Fiber Plant

DocDB #: ??

The ATLAS L1Calo Tile fiber plant project is a project to design and build an optical fiber patch panel (or fiber plant). The tile fiber plant routes data from the ATLAS Tile calorimeter to the eFEX, jFEX and gFEX boards. The LAr calorimeter signals are routed to the FEX boards through an existing fiber plant (Fiber-Optic eXtractor). The Tile fiber plant connects to the FOX in order to route the Tile signals to the appropriate location.

The Tile fiber plant must provide the following basic functionality: It must perform a remapping of the Tile calorimeter fibers (which are organized by the hardware front end readout) to the eta/phi FEX granularity and to the appropriate FEX system. The fibers are bundled at the tile calorimeter front end into fiber ribbons of roughly 48 fibers each. The tile fiber plant must split these fiber ribbons, and must then re-bundle the signals into other fiber ribbons which plug into the existing FOX.

The engineering requirement for this project is the detailed specification of the fiber maps from the calorimeter detector front end to the FEX systems. This includes the integration with the existing FOX system. The final mapping specification will be given to an industrial fiber manufacturer to build the fiber plant components. After production is complete, each of the components must be tested for optical transmittance. In addition, a complete optical path must be bench tested, connecting fiber plant modules with prototype Tile transmitters and FEX receivers. The system will then be assembled at CERN where the full tile fiber plant is tested and commissioned.

A list of engineering tasks associated with the tile fiber plant hardware project is given in Table 1 below. This table lists the major tasks, the associated FTE duration and the expected time-averaged engineering fraction used to calculate the calendar duration of the project. The estimates of the engineering efforts are based on the experience of the MSU engineers in previous fiber plant and trigger projects. It is expected that the engineer will spend  $\frac{1}{4}$  of his time over a period of two years. The engineer works on a personal services contract, which is estimated at \$124k per FTE in 2021 to 2023, or \$93k for the 0.75 FTE that are required.

The cost of the final fiber plant depends primarily on the number of fibers and the number of duplications.

The MSU engineers associated with this project is based at CERN and no travel funds are requested.

<u>Task Name</u>	<u>Effort (person-months)</u>	<u>Calendar Duration (months)</u>
Engineering Specification	1	6
Design	3	18
Acceptance Tests	2	6
System Tests	2	6
Project Review Preparation	1	12
<b><u>Project Total:</u></b>	<b>9 (0.75 FTE)</b>	<b>36 (total duration)</b>

Table 1: Engineering labor.

## Material

The second funding aspect of the fiber plant project is the costs of the material for the fiber plant. Testing of fibers and connectors and light transmission will be done in part with exiting commercial fiber testing equipment and in part with existing L1Calo modules.

The components for the tile fiber plant are listed in Table 2. The cost per item is estimated based on experience with the current FOX design.

Item	Cost per item	# of items	Total cost
MTP cable	\$100	120	\$12,000
MTP breakout cable	\$40	12	\$4,800
Mapping module	\$4,500	5	\$22,500
Enclosure	\$500	1	\$500
Misc parts			\$1,200
Total			\$41,000

Table 2: Tile fiber plant components.